INSTRUCTION MANUAL

Catalog 655111

Model CME 111

PULSE AMPLIFIER TEST SET

BIDDLE

INSTRUMENTS

JAMES G. BIDDLE CO.

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Model CME 111

PULSE AMPLIFIER TEST SET

James G. Biddle Company
Township Line & Jolly Road
Plymouth Meeting, Pa. 19462

Pulse Amplifier CME 111

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SECTION 1

INTRODUCTION

The Pulse Amplifier, CME 111 when used in conjunction with the Cable Test Set CME 110A, provides the following facilities:

(a) Increased sensitivity of up to 100 times.
(b) Simultaneous display of reflections of two cables.
(c) Subtracts the reflections of one cable from another and displays the difference.
(d) Enables the mis-matches caused by cross-coupling between two pairs of cables of a multi-cored cable to be displayed on the CME 110A.

The unit is fully transistorized and its power supply is derived from a socket mounted on the front panel of the CME 110A.

SECTION 2

SPECIFICATIONS

POWER SUPPLY

1. The +10 to +15V d.c. supply, normally obtained from the front panel of the front panel of the CME 110A, is fed to POWER INPUT socket on the CME 111. Current consumption approximately 55mA.

BUFFER AMPLIFIER

2. Output voltage 1 volt less than supply rail, (normally 12 volts). Input has to be greater than +1.5V before amplifier becomes operational.
   Gain approximately 2.5 with open circuit output.
   Bandwidth sufficient for 20 nanosecond pulse (100 yds. range CME 110A)
   Output impedance 180Ω.

MAIN AMPLIFIER

3. Gain - approximately 100.
   Bandwidth - approximately 0.35 - 15 MHz.
   Maximum output voltage - less than $\pm$1.5 volts
   Overall gain at minimum setting - approximately 0.6

ALT MODE

4. Chopping rate approximately 50 Hz.
   Mark/Space ratio 1/1.

OVERALL SYSTEM

5. Delay through complete system 30 nanoseconds which is equivalent to 5 yds. or air-dielectric cable. This figure does not include the delay due to all connecting cables.

Minimum distance measureable with Pulse Amplifier connected is 20 yds of air-dielectric cable.

Rejection ratio on CH1 - (minus) CH2 100:1 on 1,000 yd range

Isolation ratio between the two amplifiers at minimum gain 50:1.

AMBIENT TEMPERATURE

6. -40°C to +70°C fully operational.

SIZE AND WEIGHT

7. The pulse amplifier is housed in an enlarged lid which replaces that supplied with the original Cable Test Set. Under the instruction plate there is sufficient space to store the visor and test leads.

Height - 6.8 in. - (17.3 cm)

Width - 7.9 in. - (20.1 cm)

Depth - 5.5 in. - (14.0 cm)

Weight - 2.6 lb - (1.18 kg)

The equipment is supplied with two, 5 ft. UR 70 coaxial cables complete with appropriate plugs and test clips, and a composite lead assembly comprising of a length of UR 70 cable with a length of 14/0076 multistrand lead attached to it.

SECTION 3

WARNINGS

1. On some early models of the Cable Test Set the 390Ω resistor (R150) must be replaced with a 47Ω 2.5 watt ± 10% Welwyn type W 21 wire wound resistor before the CME 111 'Power Input' socket can be connected to the CME 110A.

   The following test can be used to determine whether the Cable Test Set has been modified. With a Multimeter on the 1A D.C. range, measure the current between the +ve BATT. MON. socket and earth. If the reading is about 30mA then the set has not been modified while a reading of 300mA indicates the change of resistor (R150) to the new value.

2. In the 'Pulse Amplifier' there is an inherent delay which is equivalent to 5 ±.5 yards of air-dielectrics cable (neglecting the length of any connecting leads).

SECTION 4

TECHNICAL DESCRIPTION

(FIG. 1)

MULTIVIBRATOR

1. Transistors VT7 and VT8 consists of a conventional multivibrator used to switch relay RL1 circuit with the exception of MR5, and MR4. MR5 isolates the relay coil from VT8 base. MR4 removes the overshoot generated in the relay coil.

   The circuit free runs at about 50 Hz only when S1 is switched to ALT (S1d3). In position CH2 (S1d2), VT7 base is earthed, cutting off VT7 and de-energizing RL1. RL1 a-c disconnects the input circuit to SKT2 and the CH1 socket is inoperative. In all other positions of S1, CH1, CH2-CH1, TX CH1 RX CH2 (S1d1, 4 and 5) the base of VT8 is shorted to earth. VT7 conducts, and RL1 is energized, RLC1 c-b is connected to L3 primary and the CH1 socket is connected into circuit.

BUFFER AMPLIFIER

2. The fast rise time transmitted pulse from the CME 110A at SKT1 is fed into the base of the emitter follower VT1. The signal developed across R2 is capacitively coupled by C1 and R3 to the emitter of VT2. This transistor is used in the grounded base configuration which provides a low input impedance and a high output impedance. The positive going output from the collector of VT2 is fed through MR1 to R7 from which the output voltage is applied to the function switch S1d pin 12. The pulse available at S1d12 may be switched to the hybrid transformer L1/L2. In position S1d11 it is applied to the CH1 socket only (CH1-TX). The diode MR1 is used to prevent large positive reflections from breaking down VT2 which is protected by its reverse bias characteristics when negative reflections are present.

MAIN AMPLIFIER

3. The received output from the hybrid transformer L1/L2 is available at S1c6 except in position S1c5 where it is taken directly from L4 (CH2-RX). From the wiper of RV1 the output is differentiated by C9/R19 with diodes MR3 and MR2 limiting the positive and negative spikes to a maximum excusion of about 1 volt.

MR2 also provides temperature compensation for VT6 because a rise in temperature which reduces the effective resistance of the base/emitter junction, of VT6 and causes the transistor to pass more current, will also decrease the resistance of MR2 which results in a smaller base/emitter bias and hence a reduction in the current passed by the transistor.

The output of amplifier VT6 is fed to successive amplifying stages VT5, VT4 and VT3 (C6 and C5 provide frequency compensation) and thence to the CME 110 via SKT1.

The output from VT3 is prevented from activating the Buffer Amplifier because its amplitude is less than the 1.5 volts necessary to switch on this amplifier.

HYBRID TRANSFORMER

4. This unit is used to prevent the transmitted pulse from the buffer amplifier from the feeding into the Main Amplifier. It is also used to algebraically subtract the reflections from one cable from those of another.

With an input pulse applied to L1 a-b pulses of about half the input amplitude are induced, in phase across the windings L1 c-d and L1 e-f. The voltage across L1 c-d induces a current flow through L2 d-c and L3 a-b (except in the CH2 position of S1 - i.e. RL1 de-energized). As a result the impedance is modified by that of the cable under test on Skt. 2 (except at CH2). This current sets up voltages across L3 a-b and L2 c-d which oppose that across L1 c-d.

Similary the voltage induced across L1 a-b is opposed by the e.m.f. across L2 e-f in parallel with C10 and RV2. If the balance control RV2 is adjusted to approximate to the reflected impedance of the test cable and the balance transformer L3, then equal amplitude voltages appear across L3 c-d and L3 e-f.

However, as these two windings are in opposition the e.m.f.'s cancel and no voltage is induced in L2 a-b.

Return signals from either balance transformer produces voltages at L1 a-b, and L2 a-b but that which is on the former winding is prevented from feeding back by the Buffer Amplifier.

When the CH1 - CH2 mode is used the INTERNAL BALANCE control is disconnected and the balance is now attained by the use of the impedance of L4, and the reference cable.

BALANCE TRANSFORMER

5. The signal which is impressed across L3 a-b is transferred across the transformer such that a positive pulse appears across winding L3 d-c and a negative pulse appears across winding L3 e-d; thus a balanced output is fed to the cable under test.

Capacitor C11 provides an a.c. earth and C16 protects L3 from d.c. voltages inadvertently applied to Skt. 2.

SECTION 5

OPERATING INSTRUCTIONS

1. As the accessory is housed in the lid of the CME 110 it is in operational position when the lid is resting on the top of the case. The leads and visor are stored behind the instruction panel which is opened by turning the two plastic fasterners located on the lower edge of the panel, one quarter of a turn each.
   Connect the composite lead from the left hand socket of the CME 111 to the Pulse Output socket on the Cable Test Set and plug in the red lead from the +ve BATT. MON. socket to the POWER INPUT socket.
   The outputs are balanced and X5 amplifier must be used on CME 110.

2. CH 1
   In order to see smaller reflections than the basic CME 110 will detect, the function switch is turned to 'CH 1' the cable under test being connected to socket CH 1. The AMPLIFIER GAIN control is turned in the fully anti-clockwise direction (minimum gain) and the INTERNAL BALANCE is varied until the portion of the trace following the initial pulse is level. The gain now may be increased in order to see the small reflections and Balance used to keep the trace level. Switching from range to range, the Balance may have to be re-adjusted to keep the trace level. Note there is a delay equivalent to 5 yds. of air dielectric cable to be SUBTRACTED from the distance measured on the CME 110.

3. CH 2
   Identical to that of CH 1 but the output is switched to CH 2 socket.

4. ALT
   The cables under test connected to both CH 1 and CH 2 are displayed simultaneously using a mechanical chopper. Differences between the lines can be seen visually. A faint third trace which has the shape of a decaying exponential may be seen. This is due to the time spent by the reed relay changing over contacts.
   Balance as before.

5. CH 1 - (minus) CH 2

This position disconnects the internal R-C balance network such that an external balancing source may be connected to CH 2. The line used for this purpose can be a faultless pair from the same multi-core cable and the display be an algebraic difference between the two. On the other hand, if both lines have identical faults the display will be level.

6. Tx CH 1 Rx CH2

In order to locate split pairs or pairs having excessive cross-talk, the CH 1 socket is connected to one pair which is known to have a fault and CH 2 is connected to another pair. In this position, the Balance control is INOPERATIVE and with the gain slowly increased from X1 any split can be seen as either a positive or negative going pulse. If the split is rectified further along the cable, this will show as a pulse of opposite polarity to the preceeding one. To assist in the recognition of these pulses, the end of the cable should have been previously located on one of the preceeding functions.
On the other hand, if the trace consists of a multitude of minor reflections, without any significant pulses visible, select other pairs for maximum reflection at a given gain level.

NOTE: In this mode, the accessory can only see signals entering CH 2 and will not see any reflections on the cable connected to CH 1. Therefore, all information on the trace will be the result of cross coupling of some kind.

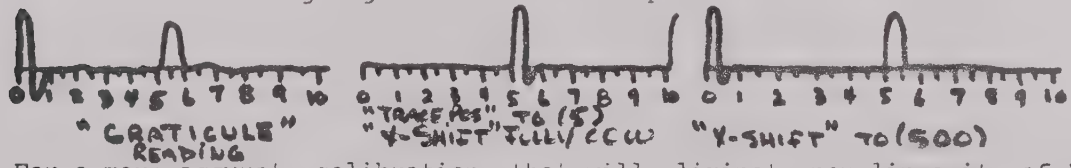
1. Turn power "ON, OFF, CHARGE" switch to the "ON" position.

2. Adjust "INTENSITY" and "FOCUS" for a clear trace.
   If outside make sure the filter is in place on the C.R.T.
   Also, if you're with a telephone company a #9 splicing enclosure may be used to supply additional shielding for the bright sunlight.
   If you are wearing sunglasses, please remove to view the trace.

3. Turn range switch to range which includes length of cable to be tested.
   Example: Cable 150 feet long use the 100 yard range

4. Set Cable Dielectric Switch to known Dielectric position. If unknown, turn to "VARIABLE" and proceed as follows:

5. Adjust the "TRACE POSITION" so that the leading edge of the transmitted pulse is at (0) on the Graticule. Observe the trace, using the "VARIABLE" control adjust the distance to the leading edge of the return pulse to equal distance to the end of a known good conductor having the same dielectric as the faulted conductor to be tested.
   Example: Good conductor 150 feet long equals 50% of 100 yd. range.
   Leading edge of end of cable pulse.



6. For a more accurate calibration, that will eliminate non-linearity of the C.R.T., adjust the "TRACE POSITION" so that the leading edge of the transmitted pulse is at (5) making sure the "X-SHIFT" control is set fully counterclockwise (0). Now adjust the "X-SHIFT" control clockwise until it indicates 500. The leading edge of the return pulse should be at (5). If not, adjust the "VARIABLE" control then check the transmitted pulse and reset for (0). Adjusting "VARIABLE" will affect the (0) position of the trace.

7. To repeat this variable setting in the future you must have a reference setting, therefore, position the "CAL" switch down. Position range switch to the 100 yd. position. Adjust "TRACE POSITION" control to position leading edge of transmitted pulse to (5) making sure the "X-SHIFT" control is at its' zero position. Now adjust "X-SHIFT" to position leading edge of return pulse at (5). Read the "X-SHIFT" control to find number to be used when calibrating for this type of cable in the future .
   Example: .720 a number which represents pulp type insulation on new <u>dry</u> telephone cable

8. Additional Calibration Procedure: Place "CABLE DIELECTRIC" control on any position, take distance reading each end terminals 1(T1) and 2 (T2) of cable on the chosen "CABLE DIELECTRIC" position: for example, "POLYETHYLENE". Then compute:

$$\frac{T1}{T1 + T2} \times \text{accurate length of cable} = \text{Distance to Fault from T1}$$

9. Position "CAL" switch up and begin observation of cable. If an accuracy of ±5% of range is acceptable simply read the distance between pulses on the Graticule using Graticule marks as a percentage of the range. For an accuracy of ±2% of range use the "X-SHIFT" control as described previously.

10. If additional gain (Signal Amplitude) is required position the "VERT. X5" switch down to couple signals thru a (X5) amplifier. For most situations this amplifier is adequate; however, for those times when it is not, proceed with the next schedule.

WHEN TO USE CME-111 AND HOW IT WORKS

1. This * amplifier aids in finding:
   a. Dents in tubes of coaxial systems
   b. Crosses and splits in communications cable
   c. Capacitance mismatches on data circuits
   d. Hi Z faults which usually have a capacitive mismatch

   * Place "VERT X5" switch in "VERT X5" position when using CME-111

2. It provides additional gain - up to X100. Also, it provides a balanced output and it has a built in Differential Amplifier.

3. Use this amplifier to compare a good and a faulty conductor.

4. Place a good conductor to "CH.1" and the faulty conductor to "CH.2". Now view either "CH.1" or "CH.2" function switch position or view both cables simultaneously on "ALT".

5. When on "ALT." increase the gain, adjusting "BALANCE" for a level trace for each new gain setting, until the traces start to separate. The point of separation is the point of *discontinuity and may not be a fault on voice circuits but usually is on data, carrier, and coaxial systems.

   **The acceptance level on certain less severe discontinuities has not been decided when using this set. Further tests will be necessary to establish this.

6. "CH.1" - "CH.2" may be used to subtract the good and faulty trace yielding the fault location.

7. Further the "TX CH.1 RXCH.2" position is used for splits with very good success. Trace should appear with a transmitted pulse with a pulse from a split and one from a corrected split (re-split). The first splits' pulse polarity is always undetermined and opposite to that of the re-split.

8. *The "GAIN" should be first adjusted so that the transmitted and end of cable pulses have maximum amplitude without being flat topped (over-driven). When looking for Hi Z and/or minute faults it will be necessary to overdrive the two pulses mentioned, keeping trace level by use of the "BALANCE" control, in order to see small signal differences with function switch on "ALT." position.

SECTION 6

MAINTENANCE INSTRUCTIONS

1. REMOVAL FROM LID

To remove the unit from its housing unscrew the four 6 B.A. chrome button-head screws situated at the extreme corners of the front panel. Take hold of the INTERNAL BALANCE knob and withdraw the instrument gently out of the lid. When replacing the unit make sure that the back edge of the P. C. Board is pushed against the foam rubber strip stuck at the back of the lid.

2. REPLACEMENT OF THE REED RELAY

During the life of the instrument the reed relay may need replacing as this part has a limited life.

De-solder the three single strand 24 swg., bare tin copper wires from the ends of the relay noting the connections. Using a sharp edge, but between the two grey plastic end pieces, taking care only to break the adhesive.

Remove the pieces and withdraw the reed.

The re-assembly is the reverse of the above using a smear of good quality plastic adhesive to replace the end pieces.

SECTION 7

COMPONENTS LIST

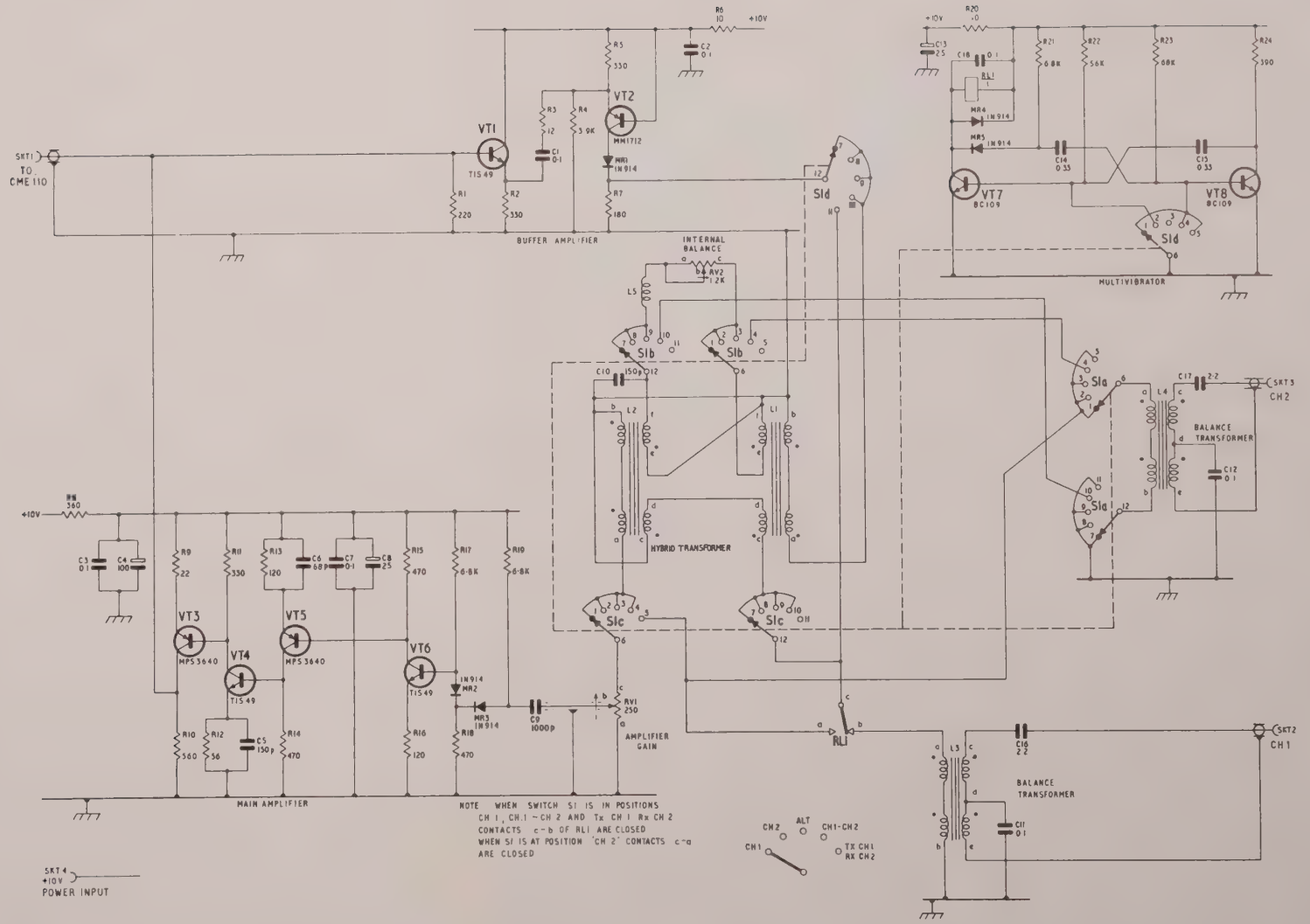
Cat. Ref.	Description	Ref. No.	Value	Tol. ± %	Rating	Cossor Ref.
	CAPACITORS					
C1	Wima MKS		.1µF	20	100V	ITB6081/15
C2	Erie 811/T/18V		.1µF		18V	ITB6124/9
C3	Erie 811/T/18V		.1µF		18V	ITB6124/9
C4	Wima		100µF	+50-20	35V	B910093/25
C5	Mial 611-1		150pF	20	25V	IUB6142
C6	Mial 611-1		150pF	20	25V	IUB6142
C7	Erie 811/T/18V		.1µF		18V	IUB6124/9
C8	Wima		25µF	+50-20	30V	B910093/23
C9	Mial 611-1		1000pF	20	25V	IUB6142/2
C10	Mial 611-1		150pF	20	25V	IUB6142
C11	Wima MKS		.1µF	20	100V	ITB6081/15
C12	Wima MKS		.1µF	20	100V	ITB6081/15
C13	Wima		25µF	+50-20	30V	B910093/23
C14	Wima MKS		.33µF	20	60V	ITB6081/31
C15	Wima MKS		.33µF	20	60V	ITB6081/31
C16	Hunts AM437		2.2µF	10	400V	IUB6141/28
C17	Hunts AM437		2.2µF	10	400V	IUB6141/28
C18	Erie 811/T/18V		.1µF		18V	ITB6124/9
	COILS					
L1	Inductance Former FX2754					KA31872
L2	Inductance Former FX2754					KA31872
L3	Inductance Former FX2754					KA31873
L4	Inductance Former FX2754					KA31873

Cat. Ref.	Description	Ref. No.	Value	Tol. ± %	Rating	Cossor Ref.
	DIODES					
MR1	IN914					IUB9036
MR2	IN914					IUB9036
MR3	IN914					IUB9036
MR4	IN914					IUB9036
MR5	IN914					IUB9036
	POTENTIOMETERS					
RV1	Morganite U		250			IUB8021/25 120/11
RV2	Morganite U		1.2K			IUB8021/12 220/11
	RELAY & SWITCH					
RL1	B & R Relay RO9/1					
	Switch MR 201					ISB9609
	RESISTORS					
R1	Piher WP051		220	5	½W	IUB3540/33
R2	Piher WP051		330	5	½W	IUB3540/37
R3	Piher WP051		12	5	½W	IUB3540/3
R4	Piher WP051		3.9K	5	½W	IUB3540/63
R5	Piher WP051		330	5	½W	IUB3540/37
R6	Piher WP051		10	5	½W	IUB3540/1
R7	Piher WP051		180	5	½W	IUB3540/31
R8	Piher WP051		360	5	½W	IUB3540/38
R9	Piher WP051		22	5	½W	IUB3540/9
R10	Piher WP051		560	5	½W	IUB3540/43
R11	Piher WP051		330	5	½W	IUB3540/37
R12	Piher WP051		56	5	½W	IUB3540/19
R13	Piher WP051		120	5	½W	IUB3540/27
R14	Piher WP051		470	5	½W	IUB3540/41
R15	Piher WP051		470	5	½W	IUB3540/41
R16	Piher WP051		120	5	½W	IUB3540/27

SECTION 7 (continued)

Cat. Ref.	Description	Ref No.	Value	Tol. ± %	Rating	Cossor Ref.
	RESISTORS (contd.)					
R11	Piher WP051		330	5	½W	IUB3540/37
R12	Piher WP051		56	5	½W	IUB3540/19
R13	Piher WP051		120	5	½W	IUB3540/27
R14	Piher WP051		470	5	½W	IUB3540/41
R15	Piher WP051		470	5	½W	IUB3540/41
R16	Piher WP051		120	5	½W	IUB3540/27
R17	Piher WP051		6.8K	5	½W	IUB3540/69
R18	Piher WP051		470	5	½W	IUB3540/41
R19	Piher WP051		6.8K	5	½W	IUB3540/69
R20	Piher WP051		10	5	½W	IUB3540/1
R21	Piher WP051		6.8K	5	½W	IUB3540/69
R22	Piher WP051		56K	5	½W	IUB3540/91
R23	Piher WP051		68K	5	½W	IUB3540/93
R24	Piher WP051		390	5	½W	IUB3540/39
	SOCKETS					
SKT1	Greenpar GE 40010					ISB2631
SKT2	Greenpar GE 40010					ISB2631
SKT3	Greenpar GE 40010					ISB2631
SKT4	Belling & Lee L1529/AG/RED					A910154/1
	TRANSISTORS					
VT1	T1S49 or ZTX314					ISB9103 ISB9104
VT2	MM1712 or TM1712					B99165/4 B910247/4
VT3	MPS3640					ISB9102
VT4	T1S49 or ZTX314					ISB9103 ISB9104

Cat. Ref.	Description	Ref. No.	Value	Tol ± %	Rating	Cossor Ref.
	TRANSISTORS (contd.)					
VT5	MPS3640					ISB9102
VT6	T1S49 or ZTX314					ISB9103 ISB9104
VT7	BC109					ISB9101
VT8	BC109					ISB9101



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ISSUE B

PULSE AMPLIFIER TYPE CME III CIRCUIT DIAGRAM

FIGURE 1
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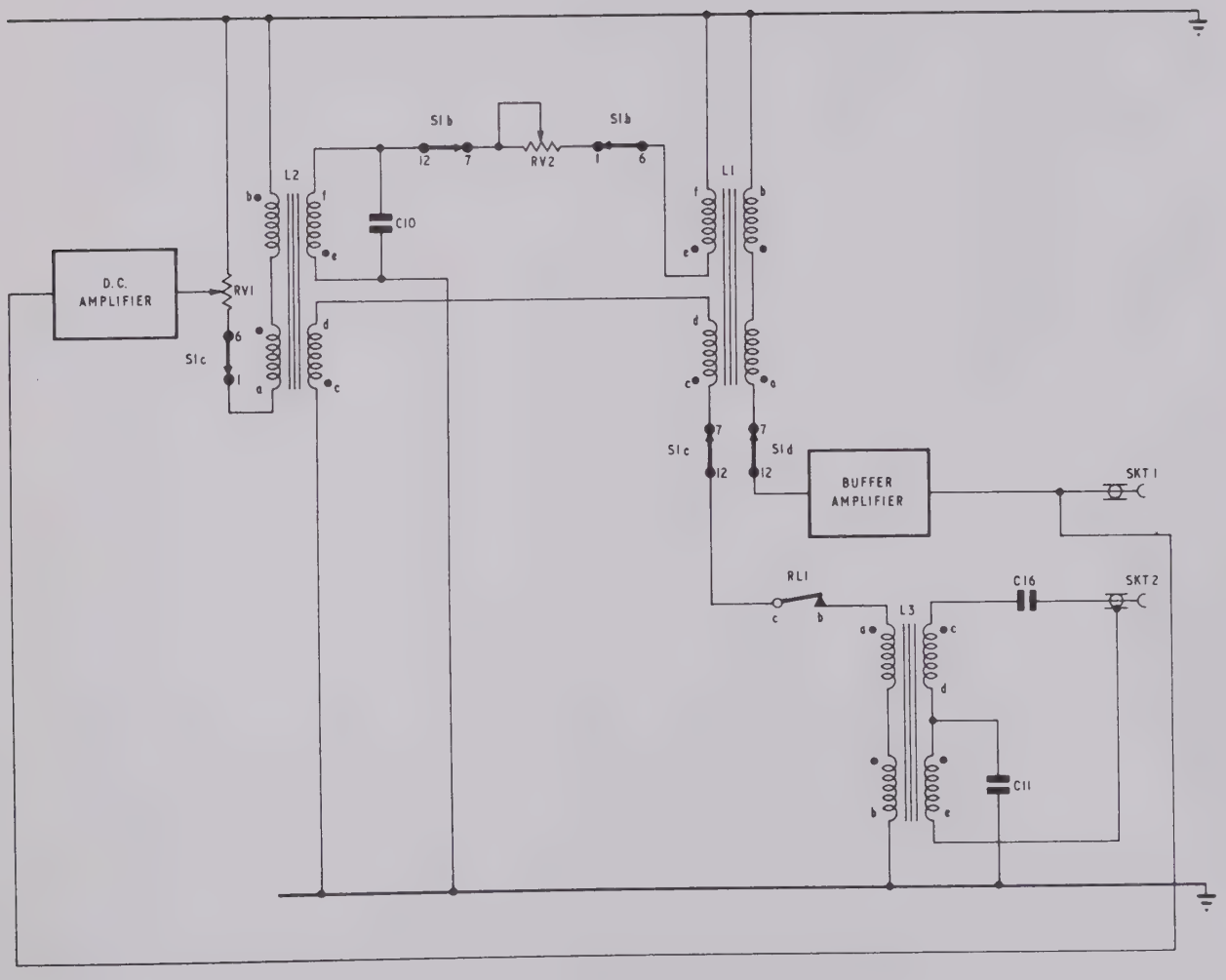
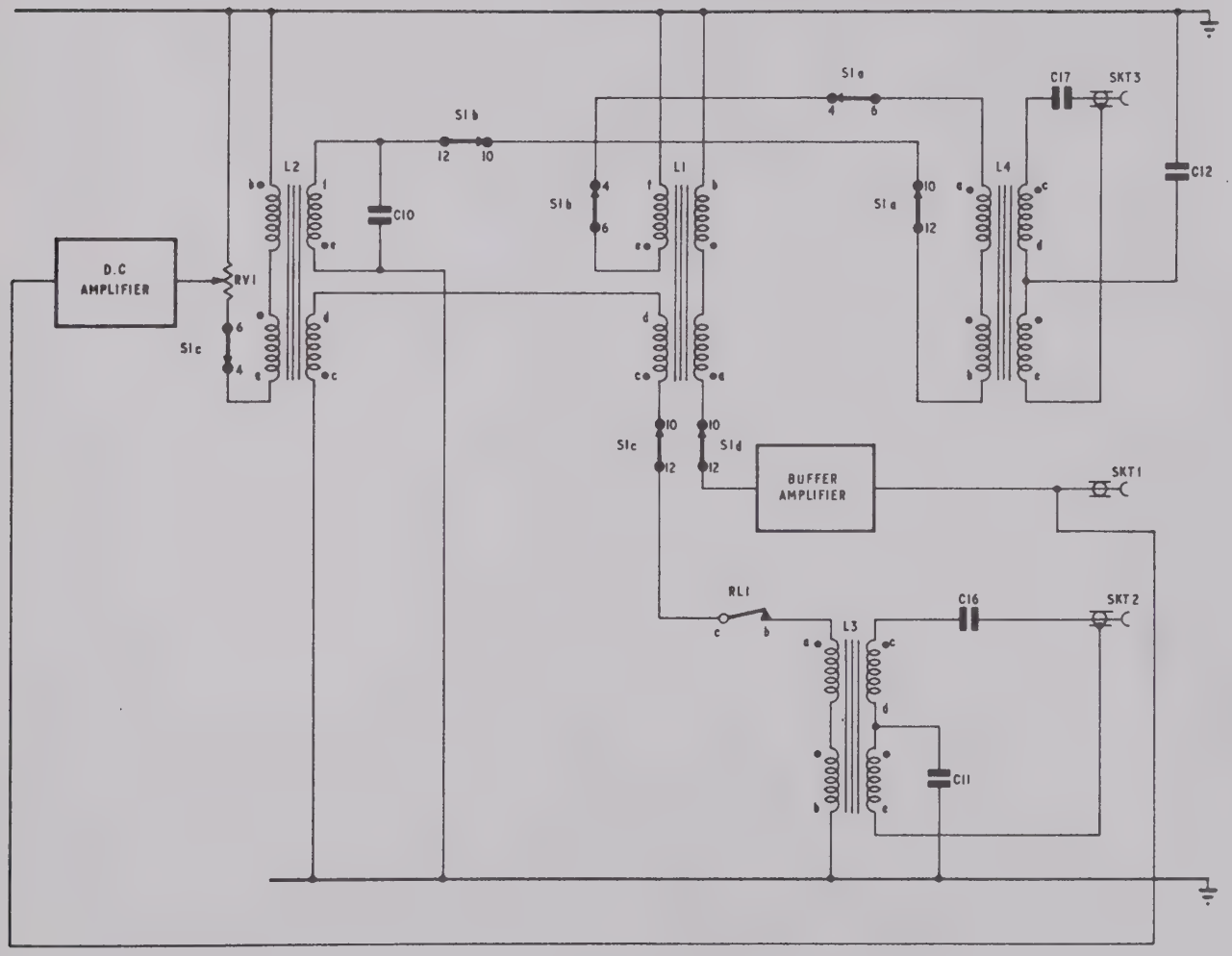


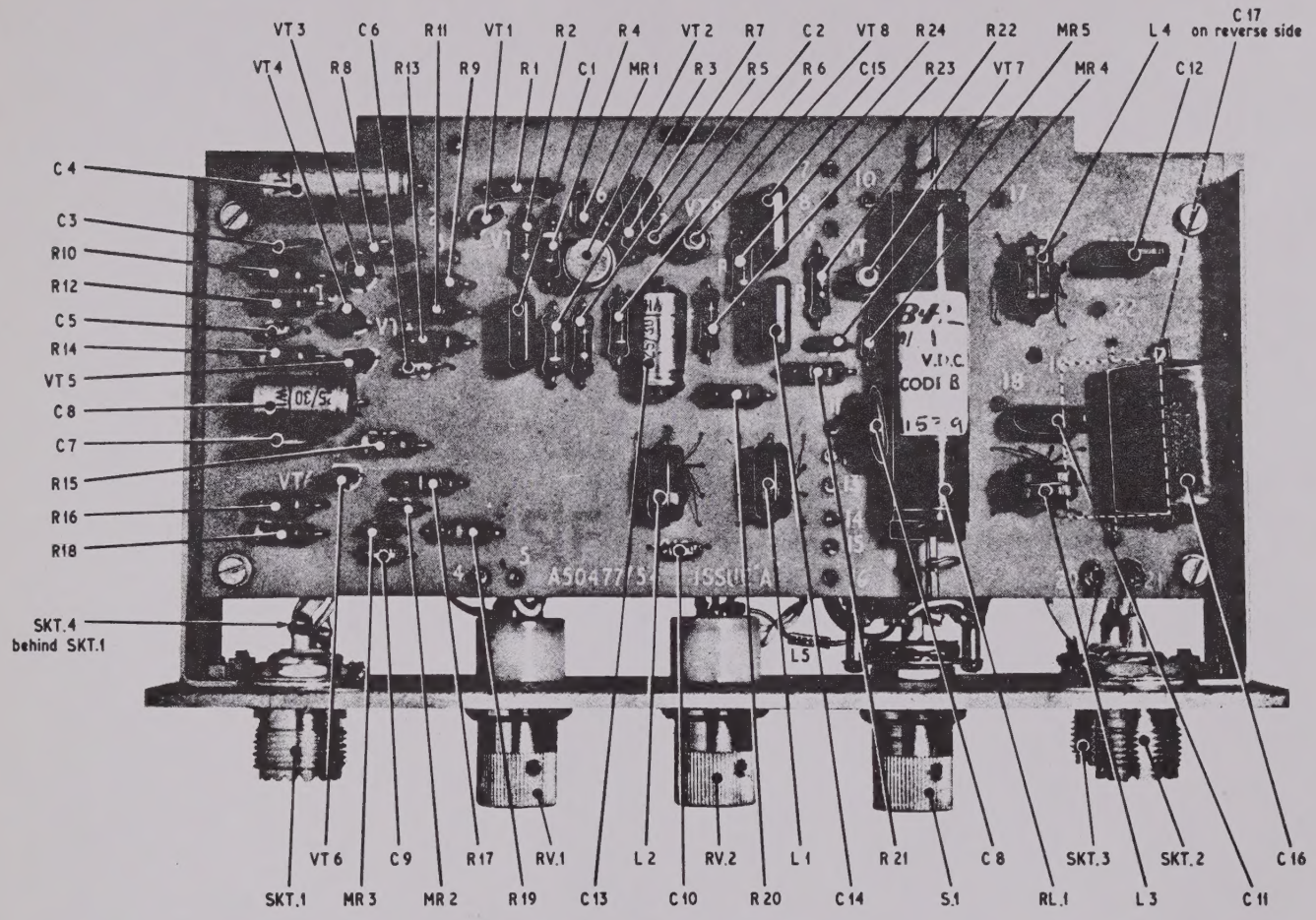
CH.1 OPERATION

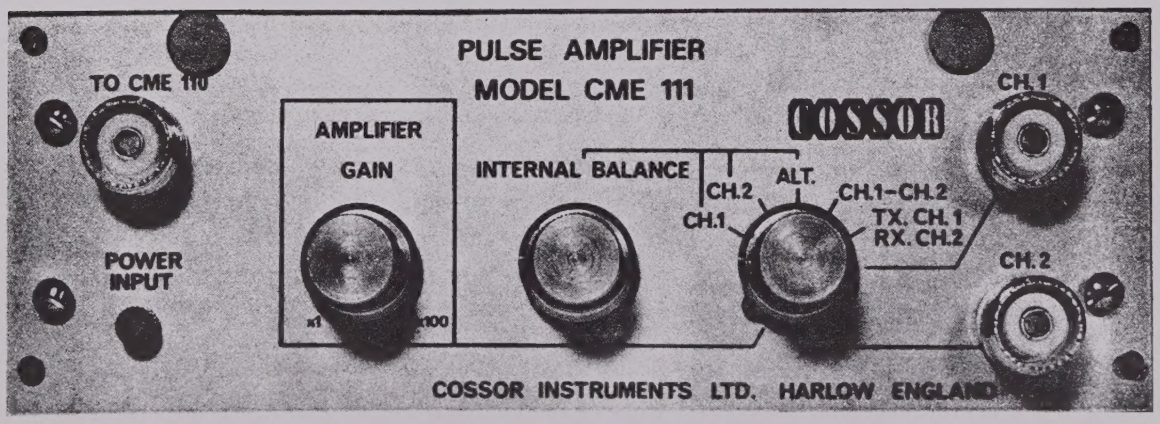
FIG. 2



CH.1 - CH.2 OPERATION

FIG. 3





Component Layout

Fig. 4

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1000230